

Claims

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[c1]

A method of inspecting a jet pump beam in a nuclear reactor, the reactor comprising at least one jet pump assembly with each jet pump assembly comprising at least one jet pump beam, each jet pump beam comprising a beam bolt opening, a first arm, a second arm, a top surface, and a bottom surface, said method comprising:

positioning at least one ultrasonic phased array probe adjacent the bottom surface of the jet pump beam; and

scanning the jet pump beam with the at least one ultrasonic phased array probe.

[c2]

A method in accordance with Claim 1 wherein positioning at least one ultrasonic phased array probe comprises positioning a first ultrasonic phased array probe adjacent the bottom surface of the jet pump beam first arm, said method further comprising:

scanning the jet pump beam first arm with the first ultrasonic phased array probe;

re-positioning the first ultrasonic phased array probe adjacent the bottom surface of the jet pump beam second arm; and

scanning the jet pump beam second arm with the first ultrasonic phased array probe.

[c3]

A method in accordance with Claim 1 wherein positioning at least one ultrasonic phased array probe comprises:

positioning a first ultrasonic phased array probe adjacent the bottom surface of the jet pump beam first arm; and

positioning a second ultrasonic phased array probe adjacent the bottom surface of the jet pump beam second arm.

[c4]

A method in accordance with Claim 3 wherein scanning the jet pump beam comprises:

scanning the jet pump beam first arm with the first ultrasonic phased array probe; and

scanning the jet pump beam second arm with the second ultrasonic phased

array probe.

[c5]

A method in accordance with Claim 1 wherein each jet pump assembly comprises a first jet pump beam and a second jet pump beam, and positioning at least one ultrasonic phased array probe adjacent the bottom surface of the jet pump beam comprises:
positioning a first ultrasonic phased array probe adjacent the bottom surface of the first jet pump beam first arm; and
positioning a second ultrasonic phased array probe adjacent the bottom surface of the second jet pump beam first arm.

[c6]

A method in accordance with Claim 5 wherein scanning the jet pump beam comprises:
scanning the first jet pump beam first arm with the first ultrasonic phased array probe;
scanning the second jet pump beam first arm with the second ultrasonic phased array probe;
re-positioning the first ultrasonic phased array probe adjacent the bottom surface of the first jet pump beam second arm;
re-positioning the second ultrasonic phased array probe adjacent the bottom surface of the second jet pump beam second arm;
scanning the first and second jet pump beam second arms with the first and second ultrasonic phased array probes respectively.

[c7]

A method in accordance with Claim 1 wherein each jet pump assembly comprises a first jet pump beam and a second jet pump beam, and positioning at least one ultrasonic phased array probe adjacent the bottom surface of the jet pump beam comprises:
positioning a first ultrasonic phased array probe adjacent the bottom surface of the first jet pump beam first arm;
positioning a second ultrasonic phased array probe adjacent the bottom surface of the first jet pump beam second arm;
positioning a third ultrasonic phased array probe adjacent the bottom surface of the second jet pump beam first arm; and

positioning a fourth ultrasonic phased array probe adjacent the bottom surface of the second jet pump beam second arm.

[c8] A method in accordance with Claim 7 wherein scanning the jet pump beam comprises:
scanning the first jet pump beam first arm with the first ultrasonic phased array probe;
scanning the first jet pump beam second arm with the second ultrasonic phased array probe;
scanning the second jet pump beam first arm with the third ultrasonic phased array probe;
scanning the second jet pump beam second arm with the fourth ultrasonic phased array probe.

[c9] A method in accordance with Claim 1 wherein scanning the jet pump beam comprises scanning the jet pump beam with the at least one ultrasonic phased array probe so that a scanned volume of the jet pump beam comprises an area extending from the bolt opening to the end of the first beam arm and that extends from the top surface of the beam at least partially towards the bottom of the beam.

[c10] A method in accordance with Claim 9 wherein scanning the jet pump beam further comprises scanning the jet pump beam with the at least one ultrasonic phased array probe so that a scanned volume of the jet pump beam further comprises and an area extending from the bolt opening to the end of the second beam arm and that extends from the top surface of the beam at least partially towards the bottom of the beam.

[c11] A method of inspecting a jet pump beam in a nuclear reactor, the reactor comprising at least one jet pump assembly with each jet pump assembly comprising at least one jet pump beam, each jet pump beam comprising a beam bolt opening, a first arm, a second arm, a top surface, and a bottom surface, each beam arm comprising a transition portion and a radiused portion located adjacent the transition portion, said method comprising:
positioning at least one ultrasonic phased array probe adjacent the bottom

surface of the jet pump beam; and
scanning at least one of the transition portion and the radiused portion of each
jet pump beam arm with the at least one ultrasonic phased array probe.

[c12] A method in accordance with Claim 11 wherein positioning at least one
ultrasonic phased array probe comprises positioning a first ultrasonic phased
array probe adjacent the bottom surface of the jet pump beam first arm, and
said method further comprising:

scanning at least one of the transition portion and the radiused portion of the
jet pump beam first arm with the first ultrasonic phased array probe;

re-positioning the first ultrasonic phased array probe adjacent the bottom
surface of the jet pump beam second arm; and

scanning at least one of the transition portion and the radiused portion of the
jet pump beam second arm with the first ultrasonic phased array probe.

[c13] A method in accordance with Claim 11 wherein positioning at least one
ultrasonic phased array probe comprises:
positioning a first ultrasonic phased array probe adjacent the bottom surface of
the jet pump beam first arm; and
positioning a second ultrasonic phased array probe adjacent the bottom surface
of the jet pump beam second arm.

[c14] A method in accordance with Claim 13 wherein scanning the jet pump beam
comprises:
scanning at least one of the transition portion and the radiused portion of the
jet pump beam first arm with the first ultrasonic phased array probe; and
scanning at least one of the transition portion and the radiused portion of the
jet pump beam second arm with the second ultrasonic phased array probe.

[c15] A method in accordance with Claim 11 wherein each jet pump assembly
comprises a first jet pump beam and a second jet pump beam, and positioning
at least one ultrasonic phased array probe adjacent the bottom surface of the
jet pump beam comprises:
positioning a first ultrasonic phased array probe adjacent the bottom surface of
the first jet pump beam first arm; and

positioning a second ultrasonic phased array probe adjacent the bottom surface of the second jet pump beam first arm.

[c16]

A method in accordance with Claim 15 wherein scanning the jet pump beam comprises:

scanning at least one of the transition portion and the radiused portion of the first jet pump beam first arm with the first ultrasonic phased array probe;
scanning at least one of the transition portion and the radiused portion of the second jet pump beam first arm with the second ultrasonic phased array probe;
re-positioning the first ultrasonic phased array probe adjacent the bottom surface of the first jet pump beam second arm;
re-positioning the second ultrasonic phased array probe adjacent the bottom surface of the second jet pump beam second arm;
scanning at least one of the transition portion and the radiused portion of the first and second jet pump beam second arms with the first and second ultrasonic phased array probes respectively.

[c17]

A method in accordance with Claim 11 wherein each jet pump assembly comprises a first jet pump beam and a second jet pump beam, and positioning at least one ultrasonic phased array probe adjacent the bottom surface of the jet pump beam comprises:

positioning a first ultrasonic phased array probe adjacent the bottom surface of the first jet pump beam first arm;
positioning a second ultrasonic phased array probe adjacent the bottom surface of the first jet pump beam second arm;
positioning a third ultrasonic phased array probe adjacent the bottom surface of the second jet pump beam first arm; and
positioning a fourth ultrasonic phased array probe adjacent the bottom surface of the second jet pump beam second arm.

[c18]

A method in accordance with Claim 17 wherein scanning the jet pump beam comprises:

scanning at least one of the transition portion and the radiused portion of the first jet pump beam first arm with the first ultrasonic phased array probe;

scanning at least one of the transition portion and the radiused portion of the first jet pump beam second arm with the second ultrasonic phased array probe; scanning at least one of the transition portion and the radiused portion of the second jet pump beam first arm with the third ultrasonic phased array probe; scanning at least one of the transition portion and the radiused portion of the second jet pump beam second arm with the fourth ultrasonic phased array probe.

[c19] A method in accordance with Claim 11 wherein scanning at least one of the transition portion and the radiused portion of the jet pump beam comprises scanning at least one of the transition portion and the radiused portion of the jet pump beam with the at least one ultrasonic phased array probe so that a scanned volume of the jet pump beam comprises an area extending from the bolt opening to the end of the first beam arm and that extends from the top surface of the beam at least partially towards the bottom of the beam.

[c20] A method in accordance with Claim 19 wherein scanning at least one of the transition portion and the radiused portion of the jet pump beam further comprises scanning at least one of the transition portion and the radiused portion of the jet pump beam with the at least one ultrasonic phased array probe so that a scanned volume of the jet pump beam further comprises and an area extending from the bolt opening to the end of the second beam arm and that extends from the top surface of the beam at least partially towards the bottom of the beam.